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The Technique of Tracheotomy and Intubation of the Larynx.

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THE TECHNIQUE OF TRACHEOTOMY AND INTUBATION OF THE LARYNX.

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Laryngeal diphtheria or membranous croup is a disease most frequently met by the general practitioner of medicine. Medical measures, with but rarely an exception, are impotent to avert a fatal result, and the physician is compelled to resort to surgical means to give his patient any chances of life. Surgical science offers two methods of relieving the impending suffocation—*tracheotomy*, an old and well tried operation, and its recently introduced rival, *intubation*. Both of these operations show such a percentage of recoveries that the physician who has not given his cases of croup, in which death threatens from suffocation, the certain relief from the horrible dyspnœa, and the prospect of recovery which either operation affords, has not done his duty.

The occasion demanding one of these operations is always urgent, and general practitioners, especially those removed from easy access to a skilled operator, should be well prepared to meet the emergency. Although the objective point of tracheotomy is superficial, and the tissues cut through are, under ordinary circumstances, insignificant, the conditions under which it is performed often make it one of the formidable operations in surgery. The time given the operator to enter the trachea is often reduced to seconds, and perfect coolness and the greatest skill are necessary to save the patient's life. Death under the operator's hands results more frequently in this operation, I believe, than in any other. These facts make the operation dreaded even by those skilled in its performance, and excuse hesitation to undertake it

on the part of the physician unfamiliar with its details. Intubation, on the other hand, is a comparatively simple affair, and any physician with ordinary manual dexterity can, with a little practice, successfully lodge a tube in the larynx. The danger to the patient during the operation also is very slight. With these two resources no child should be allowed to die without an effort being made to save it.

Tracheotomy.—In a former article on tracheotomy (Archives of Pediatrics, September, 1885), I gave the indications for the operation, the details of after treatment, etc., but said but little of the operation itself. I am convinced from a fuller observation that a delicate and skillful operation and the minutest attention to detail have an important influence over the result. Death threatens from every quarter after tracheotomy, and to be successful the surgeon must make the best of the few conditions over which he has control. In this paper I shall speak only of the technique of the operation.

Instruments.—Emergencies may arise during the performance of a tracheotomy that demand the immediate use of certain instruments. Time presses, and none is given to improvise substitutes. The operator should therefore have within his reach everything that may be necessary.

A scalpel, probe-pointed knife, director, one or two tenacula, two suitable retractors, a soft rubber catheter, feathers, and the trachea tubes, are essential. Some of these instruments demand especial mention.

The catch forceps for arresting hemorrhage are very important. There is often no time to waste in tying ends, and with such an instrument they can be quickly seized, and the forceps, left hanging over the edges of the wound, perform the additional function of an automatic retractor.

When the trachea is incised, it is necessary to have retractors to keep the edges of the incision apart to permit respiration, and the cleansing of the trachea, and to easily admit the trachea tube. The retractors should be thin, narrow, and long enough to easily

reach the bottom of the wound. This cannot be too strongly emphasized. I have seen children's lives jeopardized and lost for the want of such an instrument.

The soft catheter, to inflate the lungs in extreme cases, should be always at hand.

I have tried several different kinds of tubes, and find the silver canula, in general use, to be the best. They may be bought in four sizes: No. 1, suitable for children under two years of age; No. 2, from two to seven years; No. 3, from seven to twelve years; No. 4, for adults. Under the shoulder of the tube should be placed an apron of mackintosh cloth or oiled silk, and under that two or three layers of surgeon's lint or antiseptic gauze. This pad serves as a dressing to the wound, and can be made fairly antiseptic, and protects it from the irritating contact of the metallic shoulder, and the secretion expelled from the tube. Another very important function it performs is to permit the easy play of the tube within the trachea during respiration, coughing, and other efforts. The depth of the trachea from the skin varies much in different individuals, and as a result of inflammatory exudation. Variations in the thickness of this pad will give different lengths to the tube.

A firm table covered with blankets, and a hard cylindrical pillow, should be provided. The operation, so far as the surgeon can make it, should be aseptic, and bichloride solution, carbolized sponges, etc., should be at hand. The child is placed upon the table, its arms tied to its side with a towel or comforter, and chloroform administered. It is rarely that the patient is so carbonized that it is safe to operate without an anæsthetic, and chloroform should be the one selected. On account of the small quantity of air that reaches the lungs, these patients go under its influence slowly. Attacks of threatening dyspnœa from paresis of the abductors and collapse of the vocal cords, often embarrass its administration, and may prove dangerous. So soon as the child is anæsthetized, its head should be thrown well back over the pillow, to throw forward the trachea and make tense the

tissues over it, and the location of the larynx and trachea carefully mapped out.

The space above the isthmus may usually be selected for the operation. Some operators, however, prefer the low operation, below the isthmus, but I cannot see that it possesses any therapeutical advantages, and is much the more difficult to perform.

The cricoid cartilage is a prominent point in children, and is the guide in making the cutaneous incision.

For the high operation, the incision should be nearly two inches long, and its middle should lie over the cricoid. Using the greatest care to make the cut exactly in the median line, the skin, superficial fascia and underlying fat may be quickly cut through. It is not best, in making this incision, to put the tissues on the stretch with the thumb and fingers; their proper relations may be thus destroyed. This exposes the deep layer of the superficial fascia, and in it may be seen coursing the anterior jugular veins, usually one on each side of the median line. When they are so placed, the cut may be continued between them through the fascia, and exposing the muscles. Frequent irregularities in the course of these veins are met with. However disposed, they are always in plain sight, and can easily be avoided. If one be cut, it is an insignificant matter; it can be quickly seized by the catch forceps.

The fascia cut through, the sterno-hyoid and sterno-thyroid muscles are exposed joined together in the median line by a thin band. These muscles may be separated by a few gentle passes with the knife point, or more safely by inserting the sharp handle of the scalpel between them, and tearing them apart from above downwards. A director may be used in making this dissection, but I find one only a hindrance. The separation of the muscles brings to view the fascia and connective tissue lying immediately over the trachea. Up to this point, if necessary, the dissection may be rapidly made. No tissues of importance are met, and if bleeding occur it is easily checked. The operator must now proceed with the greatest care. The cricoid cartilage can be felt

in the middle of the wound, and bulging up from below is the isthmus of the thyroid body; between the two is the space through which the trachea is to be opened. Imbedded in the connective tissue are dilated branches of the superior thyroid vein, branches of the superior thyroid artery, and sometimes the cricoid thyroid. Often one or two enlarged lymphatic glands further complicate matters. The operation often becomes urgent at this point, and the cutting of one of these vessels may dangerously delay it. The hemorrhage from them is often profuse, and the cut ends difficult to secure. The catch forceps are invaluable for this purpose.

The best way to get through this dangerous layer of tissue is by the method of Boze. He makes a transverse incision along the upper border of the cricoid cartilage, and, with a director or retractor, pulls it, with its imbedded structures, down, and the trachea, denuded of all its coverings, presents.

Now comes the last step in the dissection, the incision into the trachea. Whenever there is time the operator should check all hemorrhage before entering the trachea. Cases are recorded in which blood has been drawn into the lungs sufficient to suffocate. When time presses, however, I am not very particular as to this point. The trachea usually contains much mucus, pus, and soft membrane, and it will almost always tolerate a little more. When suffocation is impending, to wait until the bleeding ceases is to wait till the patient is dead. The area of the trachea denuded as above should extend from the cricoid cartilage to the third or fourth ring. Often the thyroid body extends well up on the trachea, and must be drawn downward with the other tissues. If necessary, the cricoid cartilage may be included in the incision. The trachea may be punctured with scalpel at the lower border of the wound, and incised upwards to the extent necessary to admit the tube. My own practice is to make a short incision, gently introduce the retractor before withdrawing the knife, and then deliberately enlarging the cut both ways with a probe-pointed knife. Whatever occasion for haste there was

during the operation, it is now at an end. The trachea is open, and through this opening, well separated by the retractor, respiration can go on. Membrane and mucus usually present at the opening, and these should be removed with a feather or forceps before the tube is inserted. Many operators make the introduction of the tube the supreme moment of the operation, plunging it into tracheal incision so soon as made, using the finger, or an instrument, as a guide, or trusting to fortune or force to lodge it in the trachea. Such a method is often disastrous. The tube may be pushed into the connective tissue alongside the trachea, or it may severely tear and contuse the mucous membrane. Every manipulation in a tracheotomy should be made with the greatest delicacy, and no more injury done to the tissues than is absolutely necessary. With the tracheal wound in sight, and well opened by retractors, the trachea may be explored for membrane, and the tube introduced with the greatest delicacy and deliberation.

At any time during a tracheotomy, especially when the operation is delayed till the dyspnœa is urgent, it may be necessary to rapidly enter the trachea to prevent immediate death. Apnœa may result from repeated spasmodic attacks of suffocation from the anæsthetic, or from tracheal or laryngeal obstruction by masses of membrane, etc. When the case becomes so urgent, every other consideration must give way to the necessity of giving the patient air. Unless rescued, the child's life may be measured by seconds. A perfect knowledge of the operation, and of the amount of suffocation a child will probably endure, will give the surgeon the requisite coolness to complete the dissection. Under such circumstances the operator may be tempted to apply his mouth to the wound to clear it of obstructive membrane, and I regret to say that in Mackenzie's work on diseases of the throat this pernicious advice is given. This proceeding is foolhardy in the extreme, and never necessary. With a soft catheter passed into the trachea, the lungs of the patient can be inflated from the operator's artificial expiration made by compression of the chest,

and the process repeated till the child has strength to cough out the obstruction. The wound and dressing under the tube should be well sprinkled with iodoform. It is always best to put in one or two cat-gut sutures to insure healing by first intention if possible. In spite of the unfavorable conditions present, many of these wounds will heal very kindly if properly dressed.

With the tube tied in place and respiration easy the child may be put to bed.

The operation below the isthmus differs only in a few anatomical points. The anterior jugulars are joined by a communicating branch in the lower part of the neck, and it may be impossible to avoid severing it. Over the trachea at this point there are two layers of the deep cervical fascia, and between them lies a mass of loose connective tissue. Often the thymus gland rises high in the neck, and more rarely the great vessels of the neck encroach upon the space. Once in a low operation I saw the innominate artery crossing the trachea in the lower part of the wound. Lying upon the trachea is the inferior thyroid plexus of veins, often formidably dilated and covering the whole field of operation. Lying, as this plexus does, deeply in the neck, and violently moved at each respiration, a cut into it may prove very embarrassing. Rarely the thyroidima artery courses up the median line of the trachea. The difficulty that is often experienced in avoiding wounding these important vessels makes the low operation more formidable, and it should not be undertaken unless there be sufficient time for a careful dissection.

Intubation.—Although my own experience thus far with intubation has been unfortunate, all of the ten cases operated on having died, the results obtained by other operators are so good that in the hands of the majority of practitioners it is as efficient as tracheotomy in relieving the dyspnœa of croup; and on account of its ease of application, and its less formidable nature, it is a measure that will more readily receive the support of the practitioner and the sanction of the patient's friends. Skillful

tracheotomy will, I believe, save more cases than intubation,* but the operators seem to be few who can obtain the best results.

Mode of Introduction.—The operator selects the proper tube, attaches the thread, ties the ends together, and adjusts the tube upon the applicator. The child is held upright upon the lap of the nurse, and its feet and hands wrapped firmly in a sheet or blanket. The feet are best held between the knees of the nurse. An assistant behind elevates and firmly holds the child's head with both hands. The gag is inserted well back under the molars, and the handles held in place by the left hand of the assistant. The operator, seated in front, passes the left index finger rapidly into the throat, locates the opening into the larynx and elevates the epiglottis. He then passes in the tube, holding the handle at first near the chest, rapidly elevating it and projecting it forwards until the point of the tube comes in contact with the point of the index finger, carefully slipping the tube between the tip of his finger and the epiglottis, and carrying it down well into the larynx. When it is lodged deeply in the larynx, he transfers the tip of his index finger to the top of the tube to hold it in place; then, releasing the tube from the applicator, he withdraws the plug. Assuring himself, by his finger, that the tube has remained in place during the withdrawal of the plug, he removes his finger and the gag. The relief of the dyspnœa, the peculiar tubular quality of the cough and respiration, assure him that the tube is in the larynx. After a few minutes, when it is certain that all is right, the thread may be removed. It is curious to see the annoyance that this little thread produces; and if the operator be not careful, the child will grasp it and pull out the tube.

The throats of children differ greatly one from another. In some the pharynx is roomy and the larynx placed high. In others, again, there is hardly space enough to operate, and the larynx is very low. In very young children the epiglottis is very soft,

*The author exhibited and described a set of O'Dwyer's instruments for intubation.

and doubles up when the attempt is made to pass the finger under it. In children with severe diphtheria and greatly swollen tonsils the operation is quite difficult. In a case of diphtheria last week I was compelled to perform tracheotomy, because intubation was impossible, as I was unable to reach the epiglottis with my finger without the use of more force than I thought wise.

Considerable difficulty is experienced by unskilled operators. The tube passes so easily into the œsophagus that it always enters it in preference to the larnyx. The point to remember is always to keep the tube *in front* of the guiding finger. Practice upon the cadaver is recommended, but away from the large medical centres this is rarely possible. The operator should at least master the mechanism of the applicator, and be perfectly familiar with the anatomy of the parts before the attempt is made.

The dangers of the operation are apnœa from too prolonged an effort to lodge the tube, the injury to the larynx and contiguous strictures from too violent manipulation, and suffocation from balling up of membrane in the trachea below the tube.

The judgment of the operator will prevent him from making too long an effort to lodge the tube. Repeated trials of short duration, if he do not at first succeed, are better.

The obstructions from the presence of membrane and swelling of larynx does not offer much resistance to the introduction of the tube. Any very great resistance is probably indicative of improper placing of the tube. The pushing of membrane down before the tube does not occur so frequently as would be supposed, and when it does occur, experience shows that it is not attended by much danger. Twice it has happened to me, but with the withdrawal of the tube the membrane was ejected. In one case a perfect cast of the respiratory tract, from the tip of the epiglottis to the fine ramification of one bronchus, was expelled.

This accident is more liable to happen when the membrane is loosely attached.